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ABSTRACT

This document is designed to assist teachers and administrators in Texas in the planning and implementation of the course known as Computer Mathematics I. The philosophy and intent of the course is stated, along with credit allowed, prerequisite guidelines, guidelines for teacher preparation, suggested equipment needs, sample objectives, sample activities, sample sequence of topics, evaluation information, and resource information. (PK)

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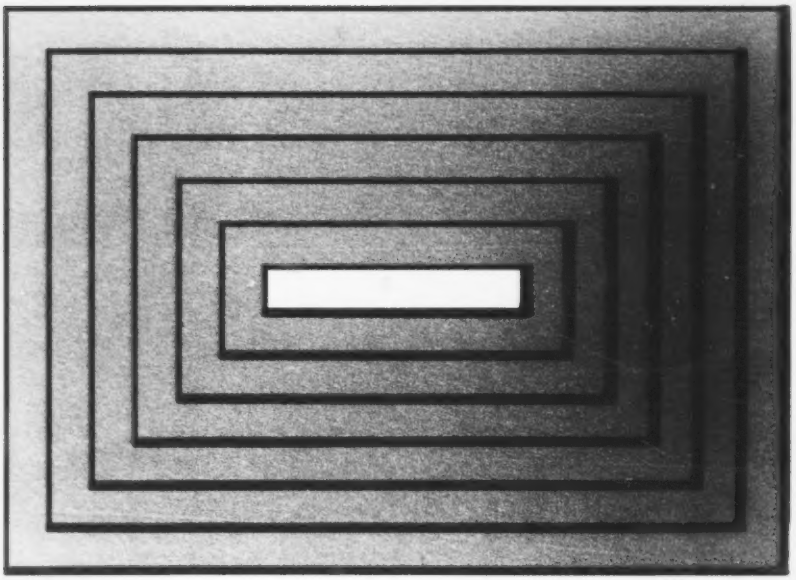

GUIDELINES FOR COMPUTER MATHEMATICS I

TEXAS EDUCATION AGENCY

SE 048 829

GUIDELINES
FOR
COMPUTER MATHEMATICS I

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Foreword

This document is designed to assist teachers and administrators in the planning and implementation of Computer Mathematics I. The philosophy and intent of the course is stated, along with credit allowed, prerequisite guidelines, guidelines for teacher preparation, suggested equipment needs, sample objectives, sample activities, sample sequence of topics, evaluation information, and resource information.

We hope these guidelines will be used by district personnel to organize classes in Computer Mathematics I and to write curriculum documents for the course.

W.N. Kirby
Commissioner of Education

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Contents

OVERVIEW OF THE COURSE

Purpose and Philosophy 1
Problem Solving 1
Reteaching and Enrichment 1
Programming Language 2
Credit 2
Prerequisite 2
Teacher Preparation 2
Equipment Needs 2

ESSENTIAL ELEMENTS AND OBJECTIVES

Essential Elements 4
Sample Objectives 5
Objective/Essential Element Matrix 10
Time Allocation 11
Sample Sequence of Topics 12
Sample Activities 14

EVALUATION: SAMPLE TEST 17

RESOURCES

Books 18
Articles 18

OVERVIEW OF THE COURSE

PURPOSE AND PHILOSOPHY

The purpose of Computer Mathematics I is to allow students to use the computer as a tool to explore and solve problems in mathematics. Students may use the computer for programming, as well as for studying topics using existing software.

Students should have completed Algebra I and a seventh or eighth grade computer literacy course prior to enrolling in Computer Mathematics I. Essential elements for the course include many topics that students may not yet have studied. Therefore, students probably will not have all the mathematical knowledge necessary for the course. Thus, teachers should expect to teach the mathematical topics in the course using the computer as an aid.

Computer Mathematics I is designed for students who are interested in using the computer to learn mathematics. It is not intended to be a course in computer programming or computer science. Throughout this document, the phrase "use the computer" is to be interpreted as "write a program in an appropriate language" or "use appropriate computer software." Students should be encouraged to continue their study of mathematics in Algebra II, Geometry, or Mathematics of Consumer Economics while participating in Computer Mathematics I.

PROBLEM SOLVING

The major focus of the mathematics program as described in *Mathematics Framework, Kindergarten-Grade 12*, Texas Education Agency Publication CU6 370 06, is to teach students to use mathematics to solve problems. Problem solving is an underlying approach to the teaching of all mathematics. Computer Mathematics I is a course that allows students to use many of the problem-solving strategies taught in the mathematics curriculum. The computer can be used as a problem-solving tool to make predictions, to validate possible solutions to problems, to investigate properties and concepts of mathematics, to perform lengthy repetitive procedures, to simulate situations, and to assist in numerous other applications. Students may use software to address various mathematical problems, or they may develop their own programs to deal with problems.

Our rapidly changing technological society requires students to be able to go far beyond the limits of what has been traditionally taught in mathematics classrooms. Computer Mathematics I is a course designed to provide students with many experiences involving higher order thinking skills, while solving problems related to algebra, geometry, number theory, probability, and consumer applications.

RETEACHING AND ENRICHMENT

Students are expected to master what is taught. When they do not, educators have the responsibility to provide reteaching so that student deficiencies are immediately remediated. In Computer Mathematics I, as in other courses, teachers should select specific methods of reteaching. Students do not need to master every application; however, if students fail to master, the teacher may introduce different applications appropriate to address the concept being taught. Teachers should diagnose the needs of students and determine the best computer application to address those needs. Enrichment activities for students are also important. Mathematics educators should design these activities to extend students' skills in logical thinking, strategic reasoning, estimation, mental arithmetic, and problem solving. For Computer Mathematics I, enrichment activities could include more depth or detail in a particular topic, more student programming experiences, and more advanced applications than presented in the regular curriculum. Thus, enrichment activities expand upon topics presented in this and other courses.

PROGRAMMING LANGUAGE

Curriculum specifications cannot possibly keep pace with rapidly changing state-of-the-art technology. Computer-based problem-solving experiences in mathematics will likely have a place in the curriculum for some time. However, details regarding types of software and the structure of various programming languages are quite likely to change rapidly in the near future. At some point, district educators may become frustrated with the requirement to use BASIC as the programming language for Computer Mathematics I. The purpose of the requirement is twofold: to expose students to the logic of a programming language and to build enough proficiency in programming that students could use programming to solve problems throughout the course. The amount of programming required will vary from class to class, depending on how the course is structured locally. Both purposes of teaching programming may be accomplished through other languages that may become more common in the future. Therefore, while the essential elements and this guide are founded on the use of BASIC as the programming language, some flexibility is possible for the course. If district educators choose to use a language other than BASIC, they may do so, provided they have on file a plan documenting that content equivalent to Essential Element 2 on BASIC programming is addressed and explaining the rationale for having selected a language other than BASIC. The plan should be available for review by the Texas Education Agency accreditation team, if requested.

CREDIT

Students may take Computer Mathematics I to fulfill one unit toward graduation in mathematics or in computer science, but not both.

PREREQUISITE

Algebra I is recommended as a prerequisite for Computer Mathematics I. Computer Mathematics I is not a prerequisite for Computer Mathematics II. Rather, Computer Mathematics II or Computer Science I should be taken by students with two or more years of college preparatory mathematics, while they continue with advanced mathematics courses.

TEACHER PREPARATION

Computer Mathematics I must be taught by a person certified to teach secondary mathematics. Teachers of the course should have a working knowledge of at least one programming language. Also, they should have experience with computer hardware. Teachers of the course should understand the course philosophy of using the computer as an instructional tool for the learning of mathematics.

EQUIPMENT NEEDS

Recommended minimal equipment for a class of 24 students includes:

- 12 microcomputers (at least 64K-128K, depending on machine), each having a monitor and at least one disk drive
- surge protection
- six printers with interface cards capable of printing graphics
- 12 system master disks (normally part of microcomputer purchase)
- 12 copies of language disks (Most microcomputers have BASIC as part of the system.)
- two blank diskettes per student per year
- printer ribbons as needed
- computer paper as needed
- adequate electrical outlets (at least three grounded outlets per computer, appropriately spaced)
- adequate tables or work stations for computers and printers

- dust covers for computers and disk drives
- dust covers for printers
- adequate cooling and control of humidity (including periods of nonuse, such as holidays and summer)
- adequate security to protect equipment
- antistatic mats connected to each computer (if computer room has a high degree of static electricity, e.g., carpeted floors)
- adequate nonmetal storage space for disks
- provision for maintenance of equipment
- appropriate manuals

Additional equipment to enhance a class of 24 students would include:

- additional microcomputers (at least 64K-128K, depending on machine) with two disk drives and monitor (possibly including color monitors)
- additional printers (possibly some plotters)
- copies of other language disks such as LOGO, Pascal, etc. (Many companies sell multiple copies of language disks at a discount.)
- appropriate software (spread sheet programs, graphing packages, other languages, etc.)
- white boards and markers
- reference books

ESSENTIAL ELEMENTS AND OBJECTIVES

ESSENTIAL ELEMENTS

Seven essential elements of instruction are listed for Computer Mathematics I in Title 19, Chapter 75 of the Texas Administrative Code. The first two essential elements are *Fundamentals of Computer Systems* and *Programming in the BASIC Language*. These elements deal with fundamental knowledge of computers and programming. The other five essential elements are *Using the Computer for Topics in Consumer Mathematics*, *Using the Computer for Topics in Algebra*, *Using the Computer for Topics in Geometry*, *Using the Computer for Topics in Number Theory*, and *Using the Computer for Topics in Probability and Statistics*.

Teachers should integrate the development of programming skills into each of the five mathematical areas, rather than teaching all the BASIC commands at one time. Where appropriate, they should consider presenting other programming techniques such as spread sheets. Furthermore, teachers should use software packages such as graphing programs and simulation programs. Other appropriate software packages are LOGO for geometry, spreadsheets for consumer topics, graphing packages for algebra, and simulation packages for probability and statistics.

Teachers should devote approximately six weeks to the first two essential elements, dealing with fundamentals of computer systems and programming in the BASIC language. They should spend approximately six weeks of time on each of the five mathematical areas. However, these should not be taught in isolation but should be integrated throughout.

Essential elements and subelements for Computer Mathematics I are as follows:

(1) Fundamentals of Computer Systems
- (A) major components, including input, storage, processing, and output
- (B) computer-system vocabulary
- (C) binary system

(2) Programming in the BASIC language
- (A) flowcharts
- (B) elements of BASIC
- (C) error messages
- (D) system commands
- (E) input and output
- (F) transfer of control
- (G) FOR-NEXT loops
- (H) arrays, functions, and subroutines
- (I) string variables
- (J) BASIC in problem-solving applications

(3) Using the Computer for Topics in Consumer Mathematics
- (A) salary, commission, and benefits
- (B) net pay
- (C) checking and savings accounts
- (D) ratio, proportion, and percent
- (E) loans and charge accounts
- (F) budgeting
- (G) investments

(4) Using the Computer for Topics in Algebra
- (A) absolute value
- (B) slope of the graph of a linear equation
- (C) x- and y- intercepts of the graph of a linear equation
- (D) graphs of functions and relations (linear, quadratic, and polynomial)
- (E) solutions to linear equations and inequalities
- (F) nth roots of numbers
- (G) arithmetic and geometric means
- (H) factorization of polynomials
- (I) solutions of quadratic equations
- (J) solutions of quadratic systems

(5) Using the Computer for Topics in Geometry
- (A) perimeter of quadrilaterals and triangles
- (B) area of rectangles, circles, triangles, trapezoids, and parallelograms
- (C) classification of angles as acute, right, or obtuse
- (D) volume of a rectangular solid, sphere, right circular cylinder, and prism
- (E) similar and congruent triangles
- (F) classification of triangles as equilateral, isosceles, or scalene
- (G) lateral area and total surface area of a right circular cylinder, and surface area of a sphere
- (H) missing sides of right triangles
- (I) collinear points in a coordinate plane
- (J) interior angles of a polygon
- (K) regular and nonregular polygons
- (L) segments and points dividing segments (midpoint, etc.)

(6) Using the Computer for Topics in Number Theory
- (A) prime numbers and relatively prime integers
- (B) perfect, abundant, and deficient numbers
- (C) greatest common divisor and least common multiple
- (D) sorting numbers
- (E) divisibility
- (F) integral factorization

(7) Using the Computer for Topics in Probability and Statistics
- (A) permutations and combinations
- (B) random numbers
- (C) mean, median, and mode

SAMPLE OBJECTIVES

Districts should develop or adapt objectives for Computer Mathematics I to bridge the gap between essential elements and actual lessons. Objectives should clarify essential elements and describe expected student outcomes.

Sample objectives teachers could use for Computer Mathematics I are listed below. The objectives are samples to clarify the essential elements. Slight modifications may be necessary; however, the philosophy of the course remains as outlined previously. Numbers in parentheses after each objective indicate possible essential elements (or subelements) that might be addressed by the objective. Note that Essential Element 2, Programming in the BASIC Language, is integrated throughout the objectives. The list is not intended to be the only set of objectives appropriate for meeting the essential elements. Different problem situations might lead to other objectives appropriate for the essential elements.

Fundamentals of Computer Systems and Programming

1. List the four functions that any computer system must encompass. (1A)
2. Describe various devices used to input information into a computer. (1A)
3. Describe the two kinds of storage, and give examples of devices used for each. (1A)
4. Describe the role of the control unit and the arithmetic-logical unit sections of the central processing unit of a computer system. (1A)
5. Describe devices used to output information from a computer. (1A)
6. Use computer terminology correctly. (1B)
7. Convert from decimal to binary and vice versa. (1C)
8. Use system command to get a directory of programs. (2D)

Topics in Consumer Mathematics

9. Given the amount of sales, the rate of commission, and the amount of deduction, calculate the wages. (3A)
10. Given the amount of sales, the rate of commission, and the amount or rate of deduction, use the computer to calculate the wages. (2A, 2B, 2C, 2E, 2F, 2J, 3A)
11. Given the gross pay, the FICA rate, and the federal tax rate, compute the net pay. (3B)
12. Given the gross pay, the FICA rate, and the federal tax rate, use the computer to compute the net pay. (2A, 2B, 2C, 2E, 2F, 2J, 3B)
13. Given the cash price, the down payment, the number of months of financing, and the monthly payment, calculate the amount financed, the amount paid in interest, and the finance charge. (3E, 3G)
14. Given the cash price, the down payment, the number of months of financing, and the monthly payment, use the computer to calculate the amount financed, the amount paid in interest, and the finance charge. (2A, 2B, 2C, 2E, 2F, 2J, 3E, 3G)
15. Given the cash price, the down payment, the number of months of financing, and the interest rate, calculate the amount financed, the monthly payment, and the amount paid in interest. (3E, 3G)
16. Given the cash price, the down payment, the number of months of financing, and the interest rate, use the computer to calculate the amount financed, the monthly payment, and the amount paid in interest. (2A, 2B, 2C, 2E, 2F, 2J, 3E, 3G)
17. Given the principal, interest rate, and number of monthly payments of a loan, compute an amortization schedule. (3D, 3E, 3G)
18. Given the principal, interest rate, and number of monthly payments of a loan, use the computer to compute an amortization schedule. (2A, 2B, 2C, 2E, 2F, 2I, 2J, 3D, 3E, 3G)
19. Given the amount of various monthly expenses, calculate the percent each expense is of the total expense. (3D, 3F)
20. Given the amount of various monthly expenses, use the computer to calculate the percent each expense is of the total expense. (2A, 2B, 2C, 2E, 2F, 2J, 3D, 3F)
21. Given the amount of a certificate of deposit (CD) and the interest rate, calculate the amount of interest. (3D, 3G)
22. Given the amount of a certificate of deposit (CD) and the interest rate, use the computer to calculate the amount of interest. (2A, 2B, 2C, 2E, 2F, 2J, 3D, 3G)

23. Given the amount of money in a savings account and the interest rate, calculate the amount of interest. (3E, 3G)

24. Given the amount of money in a savings account and the interest rate, use the computer to calculate the amount of interest. (2A, 2B, 2C, 2E, 2F, 2J, 3E, 3G)

25. Given the amounts of dates of deposits and withdrawals, reconcile a checking account. (3C)

26. Given the amounts and dates of deposits and withdrawals, use the computer to reconcile a checking account. (2A, 2B, 2C, 2E, 2F, 2I, 2J, 3C)

Topics in Algebra

27. Define the absolute value of a real number. (4A)

28. Use the computer to determine the effect of each of the parameters A, B, C, on the graph of Y = | AX + B | + C. (4A, 4D)

29. Solve a given absolute value equation or inequality by algebraic methods. (4A)

30. Solve a given absolute value equation or inequality by graphical methods. (4A, 4D)

31. Use the computer to determine the effect of each of the parameters A and B on the graph of Y = AX + B. (4B, 4C, 4D)

32. Solve a given linear equation or inequality by algebraic methods. (4E)

33. Solve a given linear equation or inequality by graphical methods. (4D, 4E)

34. Use the computer to determine the effect of each of the parameters A, B, and C on the graph of $Y = AX^2 + BX + C$. (4D)

35. Solve a given quadratic equation or inequality using graphical methods. (4D, 4I)

36. Use the computer to determine graphically the solution to a quadratic system. (4D, 4J)

37. Use the computer to examine the graphs of polynomial functions. (4D)

38. Calculate the possible rational roots of a polynomial equation with integral coefficients. (4H)

39. Use the computer to examine the relationship between the number of sign changes in a polynomial and the nature of the roots. (4D, 4H)

40. Given a polynomial equation with real coefficients, determine the number of possible positive and negative roots using Descarte's Rule of Signs. (4H)

41. Use the computer to determine graphically the solution of a system of two linear equations. (4D, 4E)

42. Solve a system of two linear equations algebraically. (4E)

43. Use the computer to add, subtract, and multiply two matrices. (2H)

44. Use the computer to find the sum of the first 100 counting numbers. (2G)

45. Use the computer to generate nth roots of a given number. (4F)

46. Use the computer to calculate the arithmetic and geometric mean of a set of positive numbers. (4G)

Topics in Geometry

47. Use the computer to calculate the perimeter of a polygon, given the lengths of the sides. (5A)

48. Given the coordinates of the vertices of a triangle or quadrilateral, calculate the areas using determinants. (5B)

49. Given the coordinates of the vertices of a triangle or quadrilateral, use the computer to calculate the area using determinants. (2A, 2B, 2C, 2E, 2F, 2J, 5B)

50. Given the coordinates of three points in a plane, use determinants to determine if the points are collinear. (5I)

51. Given the coordinates of two points in a plane, use determinants to write the equation of the line containing the two points. (5I)

52. Use the computer to examine the relationship between the number of sides of a convex polygon and the sum of the measures of the interior angles. (5J, 5K)

53. Given the coordinates of the endpoints of a segment AB and the value $K = \overline{AP}/\overline{PB}$, calculate the coordinates of point P. (5L)

54. Classify triangles based on sides and angles. (5C, 5E, 5F)

55. Use the computer to classify triangles based on sides and angles. (2A, 2B, 2C, 2E, 2F, 2J, 5C, 5E, 5F)

56. Use the computer to approximate pi using Archimedes' method of inscribed polygons. (5B, 5K)

57. For various three-dimensional objects, use the computer to examine the relationship between the length of the sides of each object and its surface area and volume. (5D, 5G)

58. Given the length of two sides of a right triangle, use the computer to calculate the length of the third side. (2A, 2B, 2C, 2E, 2F, 2J, 5H)

Topics In Number Theory

59. Define prime number, relatively prime numbers, perfect numbers, abundant numbers, deficient numbers, greatest common divisor, and least common multiple. (6A, 6B, 6C)

60. Given that A and B are natural numbers, define what "A divides B" means. (6A)

61. Use the computer to determine if an integer A divides an integer B. (2A, 2B, 2C, 2E, 2F, 2J, 6A)

62. Use the computer to classify the natural numbers as deficient, perfect, or abundant. (2A, 2B, 2C, 2E, 2F, 2J, 6B)

63. Use the computer to determine if a given number is prime or not. (2A, 2B, 2C, 2E, 2F, 2G, 2J, 6A)

64. Use the computer to generate all the prime numbers less than or equal to a given number. (2A, 2B, 2C, 2E, 2F, 2G, 2J, 6A)

65. Use the computer to determine the prime factorization of a positive integer. (2A, 2B, 2C, 2E, 2F, 2J, 6A)

66. Use the computer to determine if a number is divisible by nine, using an algorithm based on the divisibility test for nine. (6E)

67. Use the computer to determine if two numbers are relatively prime. (2A, 2B, 2C, 2E, 2F, 2J, 6A, 6F)

68. Use the computer to calculate the greatest common divisor of two natural numbers, using the Euclidean Algorithm. (2A, 2B, 2C, 2E, 2F, 2J, 6C)

Topics In Probability And Statistics

69. Calculate the number of permutations of N items taken R at a time. (7A)

70. Calculate the number of combinations of N items taken R at a time. (7A)

71. Use combinations to write the binomial expansion of $(A+B)^N$. (7A)

72. Use the computer to generate a random number between 0 and 1. (2A, 2B, 2C, 2E, 2F, 2J, 7B)

73. Use the computer to generate a random number between A and B (A < B). (2A, 2B, 2C, 2E, 2F, 2J, 7B)

74. Use the computer to simulate "the birthday problem." (2A, 2B, 2C, 2E, 2F, 2J, 7B)

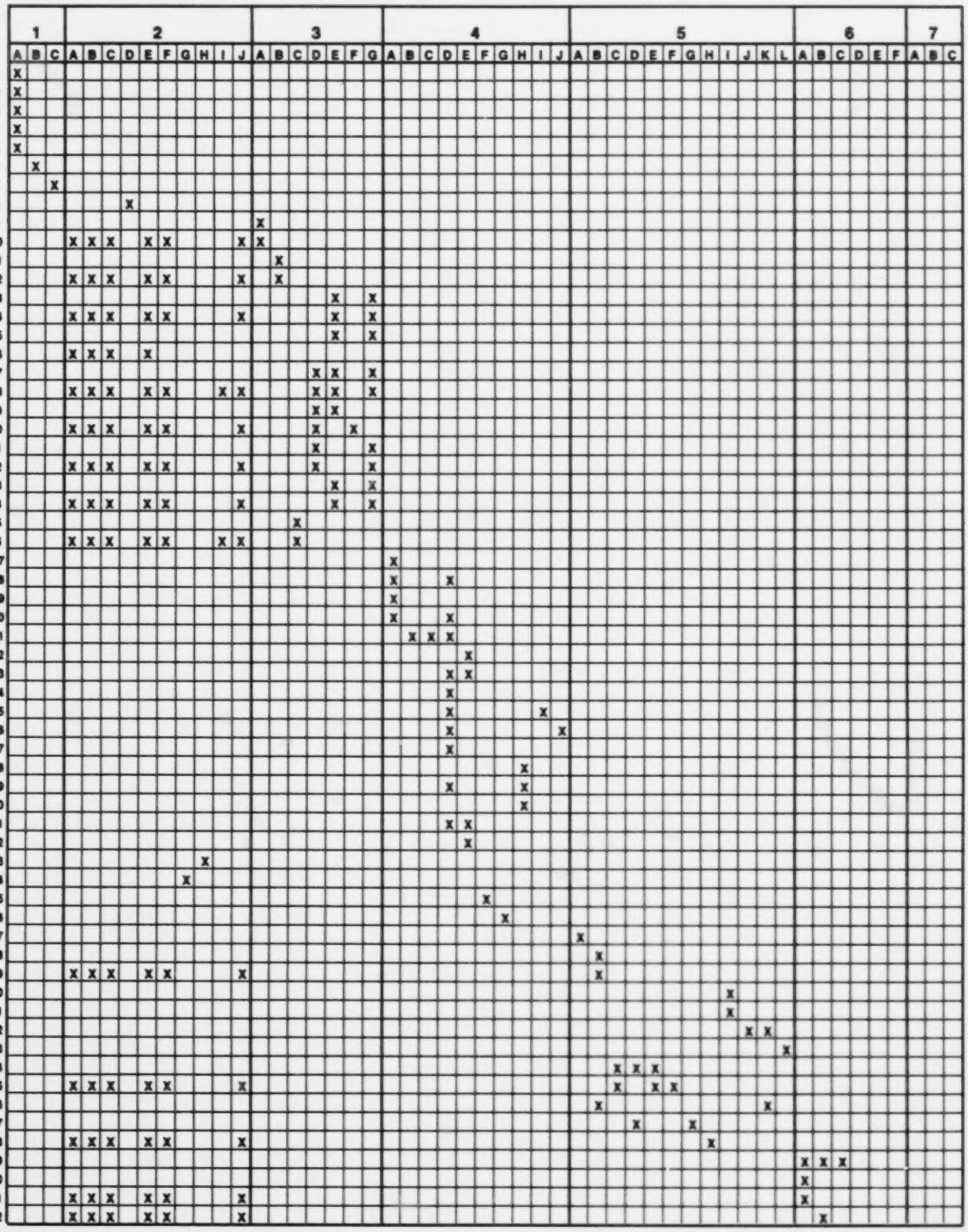
75. Use the computer to simulate a random sample from a binomial distribution. (2A, 2B, 2C, 2E, 2F, 2J, 7B)

76. Given a set of data, use the computer to calculate the mean, median, and mode, and display a graph of the data. (2A, 2B, 2C, 2E, 2F, 2J, 6D, 7C)

OBJECTIVE/ESSENTIAL ELEMENT MATRIX

This matrix indicates the match of the sample objectives listed above with the essential elements for Computer Mathematics I.

Essential Elements



Matrix, *continued*

Essential Elements

Objectives

	1			2									3							4										5											6					7		
	A	B	C	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	F	G	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	F	G	H	I	J	K	L	A	B	C	D	E	F	A	B	C
63				X	X	X		X	X	X			X																													X							
64				X	X	X		X	X	X			X																													X							
65				X	X	X		X	X				X																													X							
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76				X	X	X		X	X				X																																				X

TIME ALLOCATION

Of the 36 weeks available in a school year, no more than six weeks should be devoted to programming skills. This is not to imply teachers should spend the entire first six-week period teaching programming. Students should begin studying the mathematics as soon as possible, certainly by the beginning of the third week. The following is an allocation of time—**not** a sequence of time:

Programming skills	6 weeks
Consumer mathematics	6 weeks
Algebra	6 weeks
Geometry	6 weeks
Number theory	6 weeks
Probability and statistics	6 weeks

SAMPLE SEQUENCE OF TOPICS

One-Credit Course

The following scope and sequence of topics could comprise a one-credit course in Computer Mathematics I. Note that time is allocated for each of the topics addressed in the essential elements.

Mathematics Topic	Programming Topic	Essential Element
A divides B (approx. 1 week)	Assignment statement (LET), input, output, operations (+, -, *, /), and (INT)	Number theory
Divisors of a number Number of divisors Sum of divisors (approx. 1 week)	Loop (FOR..NEXT) Nested loop Counters & accumulators	Number theory
Prime factors Prime factorization Prime factorization of N! (approx. 2 weeks)		Number theory
Permutations and combinations (approx. 1 week)	Subroutine (GOSUB)	Probability and statistics
Wages (approx. 2 weeks)	Spreadsheet (IF-THEN, ELSE, LOOKUP)	Consumer math
Simple interest (approx. 1 week)		Consumer math
Compound interest (approx. 1 week)		Consumer math
Annuities (approx. 1 week)		Consumer math
Amortization (approx. 1 week)		Consumer math
Construct regular polygons (approx. 1 week)	Logo (FORWARD, BACKWARD, LEFT-TURN, RIGHT-TURN, REPEAT) and procedures	Geometry
Construct bar graph with vertical scale (approx. 1 week)	Logo (FIRST, IF-ELSE)	Geometry and probability and statistics
Simulations (rolling of die, sum of two die, binomial experiment, and graphing of results) (approx. 3 weeks)	Logo (RANDOM, MAKE)	Probability and statistics

Mathematics Topic	Programming Topic	Essential Element
Construct right triangles given LL and HL (approx. 1 week)	Logo (SIN, COS, TAN, and ARCTAN)	Geometry
Construct triangle SSS, SAS, ASA (approx. 2 weeks)	Logo (SQRT)	Geometry
Construct X,Y-coordinate system, graph points, calculate distance between points (approx. 1 week)	Logo	Geometry
Graph two points and line containing them (approx. 1 week)	Logo	Geometry
Examine graphs of $Y = AX + B$ (approx. 2 weeks)	Logo (FOR)	Algebra
Examine graphs of $Y = AX^2 + BX + C$ (approx. 2 weeks)	Logo	Algebra
Examine graphs of $Y = \lvert AX + B \rvert$ (approx. 2 weeks)	Logo	Algebra
Synthetic division (approx. 1 week)	Spreadsheet	Algebra
Approximate pi using Monte Carlo Method (approx. 1 week)	BASIC, Logo, or Spreadsheet	Probability and statistics
Approximate pi using Viete's and Archimedes' methods (approx. 2 weeks)	Spreadsheet	Geometry

Half-Credit Course

The following scope and sequence of topics could serve as a half-credit course in Computer Mathematics I.

Mathematics Topic	Programming Topic	Essential Element
A divides B (approx. 1 week)	Assignment statement (LET), input, output, operations (+, -, *, /), and (INT)	Number theory
Divisors of a number Number of divisors Sum of divisors (approx. 2 weeks)	Loop (FOR..NEXT) Nested loop counters and accumulators	Number theory

Mathematics Topic	Programming Topic	Essential Element
Permutations and combinations (approx. 1 week)	Subroutine (GOSUB)	Probability and statistics
Binomial expansion (approx. 2 weeks)	Arrays (DIM)	Algebra, probability and statistics
Binomial experiment (approx. 1 week)	Random numbers (RND)	Probability and statistics
Graphing of data Measures of central tendency and dispersion Simulations (approx. 2 weeks)	Arrays & sorting	Probability and statistics
Approximate pi using simulation Calculate pi using Archimedes' method (approx. 1 week)		Geometry
Arithmetic progressions Simple interest Geometric progressions Compound interest Amortization (approx. 3 weeks)	Counters and accumulators	Algebra Consumer math

SAMPLE ACTIVITIES

The following sample activities illustrate how different topic areas could be addressed:

Topic: An Integer A divides an Integer B

Activities:

- An integer A divides an Integer B means B/A is an integer
- Notation: A divides B is written as A|B
- Examples and nonexamples
- Characterizations:

  A|B if and only if there exists an integer K such that B/A = K

  A|B if and only if there exists an integer K such that B = KA
- Properties:

  If A|B and A|C, then A|(B + C)

  If A|BC and A∤B, then A|C

  If A|B and A|C then A|(BX + CY) for all integers X and Y

Topic: Greatest Integer Function

Activities:

- Use the number line to graph real numbers.
- Graph a real number X on a number line, and determine two consecutive integers N and N + 1 such that $N \leq X \leq N+1$.

  Example: If X = 1.7, then N = 1 and N + 1 = 2.

  If X = 4, then N = 4 and N + 1 = 5.

  If X = −3.4, then N = −4 and N + 1 = −3.

- Define the greatest integer of a real number X as the largest integer less than or equal to X.
- Notation: The greatest integer of a real number X is written [X].
- [X] = N where $N \leq X < N+1$.
- Examine the graph of Y = [X].
- [X] = X if and only if X is an interger.
- BASIC notation for [ ] is INT.
- A|B if and only if [B/A] = B/A.
- Using the computer, A|B if and only if INT(B/A) = B/A.
- Program for A|B.

Topic: Number and Sum of Divisors

Activities:

- Use IF-THEN and FOR-NEXT statements to print divisors of a number.

```
INPUT N
FOR I=1 TO N
    IF INT(N/I) = N/I THEN PRINT I
NEXT I
```

- Use the counter to calculate the number of divisors.

```
INPUT N
C=O
FOR I=1 TO N
    IF INT(N/I) = N/I THEN C=C+1
NEXT I
PRINT "Number of divisors of";N;"is";C
```

- Use the accumulator to calculate the sum of divisors.

```
INPUT N
S=O
FOR I=1 TO N
    IF INT(N/I) = N/I, THEN S = S+I
NEXT I
PRINT "Sum of divisors of";N;"is";S
```

- Define unit as a natural number with exactly one divisor, a prime as a natural number with exactly two divisors, and a composite number as a natural number with more than two divisors.
- Write a program to determine if a number is prime or not.
- Define deficient, abundant, and perfect numbers.
- Write a program to classify the numbers from 1 to 30 as deficient, abundant, or perfect.
- Verify that if P is a prime and $2^P - 1$ is a prime, then $2^{P-1}(2^P - 1)$ is a perfect number.
- Verify that P, P^2, . . . , P^N are all deficient numbers if P is a prime.
- Verify that if P is a prime number, then the number of divisors of P^K is $(K + 1)$.
- Verify that if P is a prime, then the sum of the divisors of P^N is $(P^{N+1} - 1)/(P - 1)$

EVALUATION: SAMPLE TEST

As Computer Mathematics I is a mathematics course, the emphasis of evaluation should be on the mathematics being taught. As appropriate, questions pertaining to the programming should be included. Thus, approximately 75-80 percent of each test should measure mathematical concepts, skills, and problem solving, while 20-25 percent should measure computer skills.

The following is an example of such a test over the first two weeks of the sample sequence of topics listed on pages 12-13:

Determine if A divides B for each of the following (1-5). State why or why not.

1. A = 4 and B = 36
2. A = 6 and B = 14
3. A = 14 and B = 14
4. A = 0 and B = 13
5. A = 13 and B = 0

For each of the following (6-8), (a) list all the divisors, (b) calculate the number of divisors, and (c) calculate the sum of the divisors.

6. $N = 2^5$
7. $N = 2^3 3^4$
8. $N = 36$

9. If P and Q are prime numbers, how many divisors does $N = P^3 Q^4$ have? Justify your answer.

10. If P and Q are prime numbers, what is the sum of the divisors of $N = P^4 Q^3$? Justify your answer.

11. Find the value of [12/5] where [ ] denotes the greatest integer function.

12. Find the value of [36/4] where [ ] denotes the greatest integer function.

13. Find the value of [– 7/3] where [ ] denotes the greatest integer function.

14. Solve [2X – 1] = 3 for X.

15. If $S = 1 + P + P^2 + P^3 + \ldots + P^N$, show that $S = \frac{P^{N+1} - 1}{P-1}$

16. Write a BASIC statement to determine if a real number A is an integer.

17. Write a BASIC statement to determine if an integer A divides an integer B.

18. Write a BASIC program that will input two numbers A and B, check to see if they are both integers, and if so, determine if A divides B.

19. Write the BASIC statements necessary to count the number of divisors of an integer N. You do not need to write the entire program, only those lines necessary.

20. Write the BASIC statements necessary to calculate the sum of the divisors of an integer N. You do not need to write the entire program, only those lines necessary.

RESOURCES

The following is a list of books and articles that can assist teachers in developing background information and instructional material for Computer Mathematics I. Also, many of these resources will be useful to students interested in enriching their learning experience through research or additional computer applications.

Software references are not included in the list. However, teachers must examine and evaluate software as to appropriateness for their instruction. Software is rapidly changing, and any software or supplementary material used may need to be reevaluated periodically to make certain that it is the best currently available.

BOOKS

Bitter, Gary G. *Microcomputer Applications for Calculus*. Prindle, Weber & Schmidt, 1983.

Elgarten, Gerald M.; Posamentier, Alfred S.; and Moresh, Stephen E. *Using Computers in Mathematics*. Addison-Wesley Publishing Company, Inc., 1986.

Golden, Neil. *Computer Programming and Algebra I*. Harcourt Brace Jovanovich, Inc., 1983.

_____. *Computer Programming and Algebra II*. Harcourt Brace Jovanovich, Inc., 1981.

_____. *Computer Programming in the Basic Language*. Harcourt Brace Jovanovich, Inc., 1981.

Merris, Russell. *Introduction To Computer Mathematics*. Computer Science Press, 1985.

Myers, David L. *Precalculus Computer Activities*. Houghton Mifflin Company, 1983.

Norris, Cathleen A. and Poirot, James. *Computer Mathematics*. D. C. Heath and Company, 1986.

Spencer, Donald D. *Computers in Number Theory*. Computer Science Press, 1982.

Ulrich, James F. *Computer Programming and Geometry*. Harcourt Brace Jovanovich, Inc., 1983.

ARTICLES

Consumer Mathematics

Bland, Paul and Givan, Betty, "An Analysis of Two Car-Buying Strategies." *Mathematics Teacher* 76 (February 1983): 124-27.

Faircloth, T. A., "Money Management: Budgeting with a Spreadsheet." *80 Micro* (November 1985): 108-11.

_____, "In Your Best Interest." *80 Micro* (April 1986): 106-10.

Harrell, John B., "On Displays: Sprucing Up Your Spreadsheet." *80 Micro* (December 1985): 81-83.

Huber, John C., "Using A Spreadsheet for Consumer Mathematics In Computer Mathematics." (1986) Sam Houston State University.

Kimberling, Clark, "From Simple Interest to e." *Mathematics Teacher* 78 (October 1985): 549-55.

McAnaney, David, "Savings and Loan." *80 Micro* (November 1985): 83-84.

Morduchow, Morris, "Discrete and Continuous Compounding." *The American Mathematical Monthly* (December 1985): 734-35.

Soler, Francisco deP., and Schuster, Richard E., "Compound Growth and Related Situations: A Problem-Solving Approach." *Mathematics Teacher* 75 (November 1982): 640-44.

Tan, Soo Tang, "A Case of True Interest." *The College Mathematics Journal* (May 1986): 247-48.

Thompson, Robert C., "The True Growth Rate and the Inflation Balancing Principle." *The American Mathematical Monthly* (March 1983): 207-10.

Vest, Floyd, "Modeling the Cost of Ownership." *Mathematics Teacher* 79 (November 1986): 610-13.

Wayment, Stanley G., "Another Question of Interest." *The Two-Year College Mathematics Journal* 11 (September 1980): 252-54.

Winterink, John A., "Some Interest." *Mathematics Teacher* 76 (November 1983): 563.

Number Theory

Brown, Susan A., "A Surprising Fact about Pythagorean Triples." *School Science and Mathematics* 78 (October 1985): 540-41.

Chiosi, Louis, "Generating an Array of Pythagorean Triples." *School Science and Mathematics* 86 (November 1986): 545-50.

Fischer, Frederic, "Exploring Number Theory With a Microcomputer." *Mathematics Teacher* 79 (February 1986): 120-22.

Flusser, Peter, "How to Solve the Diophantine Equation $x^2 + y^2 = z^2$ With Only One Literal Symbol." *Mathematics Teacher* 78 (December 1985): 708-11.

Friedlander, Richard J., "Factoring Factorials." *The Two-Year College Mathematics Journal* 12 (January 1981): 12-20.

Gantner, T.E., "The Computation of Repeating Decimals." *The Two-Year College Mathematics Journal*: 430-440

Kimberling, Clark, "Primes." *Mathematics Teacher* 76 (September 1983): 434-37.

Pethel, R.D., "Some Theorems on Deficient Numbers." *The Illinois Mathematics Teacher* 34 (November 1983): 11-17.

Pizarro, Antonio, "Computer-Generated Magic Squares." *Mathematics Teacher* 79 (September 1986): 471-76.

Szczipanski, Ronald, "Generating Primitive Pythagorean Triples: A Computer Solution." *Mathematics Teacher* 77 (March 1984): 191-92.

Tirman, Alvin, "Pythagorean Triples." *Mathematics Teacher* 79 (November 1986): 652-55.

Wallace, Edward C., and Chance, Joseph E., "Large Integers with Small Numbers." *Mathematics Teacher* 78 (May 1986): 374-77.

Algebra

Burrill, John C., and Kepner, Henry S., "Relating Graphs To Their Equations With a Microcomputer." *Mathematics Teacher* 79 (March 1979): 185-97.

Cecil, David R., "Find a Number's Roots." *80 Micro* (November 1982): 440-42.

Dreyfus, Tommy, and Eisenberg, Theodore, "A Graphical Approach to Solving Inequalities." *School Science and Mathematics* 85 (December 1985): 651-62.

Hasting, Ellen H., and Yates, Daniel S., "Microcomputer Unit: Graphing Straight Lines." *Mathematics Teacher* 76 (March 1983): 181-86.

Hirsch, Christian R., "Families of Lines." *Mathematics Teacher* 76 (March 1983): 590-94.

Kimberling, Clark, "Graph Many Functions, Part I." *Mathematics Teacher* 78 (March 1985): 195-200.

_____, "Graph Many Functions, Part II." *Mathematics Teacher* 78 (April 1985): 278-80.

_____, "Factoring and Unfactoring." *Mathematics Teacher* 79 (January 1986): 48-53.

_____, "Roots: Half-Interval Search." *Mathematics Teacher* 78 (February 1985): 12-23.

_____, "Roots: Newton's Method." *Mathematics Teacher* 78 (November 1985): 626-29.

Olson, Milfried, and Goff, Gerald K., "Applications of Synthetic Division to Graphing of Cubic Equations." *School Science and Mathematics* 85 (November 1985): 591-94.

Geometry

Addicks, Tom, "Logo in the Mathematics Classroom." *Mathematics Teacher* 79 (September 1986): 424-28.

Huber, John C., "Archimedes: Method for Calculating Pi." *Texas Mathematics Teacher* 27 (October 1980): 10-12.

_____, "Vietes' Method for Calculating Pi." *School Science and Mathematics* 84 (November 1984): 542-47.

Watkins, Will, "Vectors in a LOGO Learning Environment." *The College Mathematics Journal* 16 (September 1985): 286-300.

Probability and Statistics

Austin, Joe Dan, "The Birthday Problem Revisited." *The Two-Year College Mathematics Journal* (December 1976): 39-42

Carlson, Ronald J., "Buffon's Needle Problem on a Microcomputer." *Mathematics Teacher* 76 (November 1981): 638-40.

Collis, Betty, "Simulation and the Microcomputer: An Approach to Teaching Probability." *Mathematics Teacher* 75 (October 1982): 584-87.

Copes, Wayne; Sacco, William; Jameson, John W.; and Sloyer, Clifford, "Queues and Simulation for Secondary School Students." *Mathematics Teacher* 79 (May 1986): 343-47.

Ginther, John L., and Eubank, William A., "Using a Computer to Simulate the Birthday Coincidence Problem." *Mathematics Teacher* 75 (December 1982): 769-80.

Goodman, Terry, "Using the Microcomputer to Teach Statistics." *Mathematics Teacher* 79 (March 1986): 210-215.

Haigh, William E., "Microcomputer Unit: Generating Random Numbers." *Mathematics Teacher* 79 (February 1986): 132-36.

_____, "Using Microcomputers to Solve Probability Problems." *Mathematics Teacher* 78 (February 1985): 124-26.

Hinders, Duane C., "Monte Carlo, Probability, Algebra, and Pi." *Mathematics Teacher* 74 (May 1981): 335-39.

Hocking, Robert L., and Schwertman, Neil C., "An Extension of the Birthday Problem to Exactly k Matches." *The College Mathematics Journal* 17 (September 1986): 315-21.

Indelicato, Arthur, "Generating 'RANDOM' Numbers Using Modular Arithmetic." *Mathematics Teacher* 62 (May 1969): 385-91.

Kimberling, Clark, "Generate Your Own Random Numbers." *Mathematics Teacher* 77 (February 1984): 118-23.

_____, "The Microcomputer as an Alternative to Binomial Tables." *Mathematics Teacher* 79 (November 1986): 658-64.

Landauer, Edwin G., "Methods of Random Number Generation." *Two-Year College Mathematics Journal* (November 1977): 296-303.

Murty, Vedula N., "On the Mean and Standard Deviation of a Random Sample." *The College Mathematics Journal*: 60-63.

Myers, David, "Random Numbers." *Mathematics Teacher* 77 (February 1984): 84-85.

Roberts, Jerry A., "Accurate Computation of Variance." *The College Mathematics Journal* 16 (March 1985): 149-50.

Schroeder, Lee L., "Buffon's Needle Problem: An Exciting Application of Many Mathematical Concepts." *Mathematics Teacher* 67 (February 1974): 183-86.

Spencer, Neville, "Celebrating the Birthday Problem." *Mathematics Teacher* 70 (April 1977): 348-53.

Thomas, David A., "Understanding the Central Limit Theorem." *Mathematics Teacher* 77 (October 1984): 542-43.

Travers, Kenneth J., and Gray, Kenneth G., "The Monte Carlo Method: A Fresh Approach to Teaching Probabilistic Concepts." *Mathematics Teacher* 74 (May 1981): 327-34.

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulations by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs or activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.

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